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Effect of Daminozide on Yield and Quality of 'Concord' Grapes (*Vitis labrusca* L.) in Arkansas[1]

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Abstract. **Succinic acid -2,2-dimethylhydrazide (daminozide, SADH) applied at first-bloom or peak-bloom at 1000, 2000, or 3000 ppm did not statistically alter yield in 1969. 1000 ppm applied between first- and peak-bloom in 1970 increased yield over the control, but no yield advantage was obtained at 500, 750, or 1000 ppm in 1971. Yield increases were due mainly to increases in the number of berries/cluster when daminozide was applied during early bloom as compared to application during verasion. Berry weight was reduced when the number of berries/cluster increased. Juice quality and vegetative growth of the grapevine generally decreased as yields increased due to daminozide application. Delaying harvest of grapevines partially overcame the retardation in maturity resulting from daminozide treatment.**

In 1967, Tukey and Fleming (7) reported increases in fruit set under Pennsylvania conditions when daminozide was applied to 'Concord' and 'Himrod' grapevines. The following year, pre-bloom, first-bloom, and peak-bloom applications of daminozide increased cluster wt, yield, and fruit set of 'Concord' grapevines when covariance analysis was used to adjust for variations in vine size. In 1970, Funt (4) confirmed the effectiveness of 1000 ppm daminozide in Pennsylvania when applied at first-bloom to increase berry set, cluster wt, and yield of 'Concord' grapes.

Daminozide reduced soluble solids in certain seedless grape cultivars in New York (2), but Tukey and Fleming (8) detected no change in soluble solids when 'Concord' grapevines were treated. The size of 'Concord' berries was found to be reduced by daminozide treatment (7, 8). Work with other crops has shown that daminozide effectiveness depends upon climatic factors (1, 3, 5).

'Concord' grapes are a major fruit crop in the Ozark region of Arkansas. This study was conducted to determine if daminozide would influence production, vegetative growth, and quality of 'Concord' grapes in Arkansas.

Materials and Methods

Experiments were conducted for a 3-year period (1969-71) in a mature 'Concord' vineyard established in 1957 at the Arkansas Agricultural Experiment Station, Fayetteville. Vines were trained to a single wire cordon training system and balanced pruned to 30 + 10 nodes/vine (30 nodes retained for the first 454g of prunings and 10 additional nodes retained for each additional 454g of prunings removed). The grapevines were spaced 2.44 m in the row and 3.05 m between rows. Prior to bloom in 1969, single vine plots of uniform vine size were selected for treatment. The average weight of prunings in 1968 for these uniform vines was 1.8 kg per vine. Vines were sprayed with an aqueous solution of daminozide to the point of drip, using a 13 liter (3-gal) hand sprayer so each vine could be treated individually.

Daminozide was applied at first-bloom, peak-bloom (50-60% caps off) and at verasion in 1969; and between first- and peak-bloom in 1970 and 1971. Daminozide concn of 1000, 2000, and 3000 ppm were used in 1969; and 500, 750, and 1000 ppm were used in 1970 and 1971. Unsprayed vines served as controls for all years.

Maximum-minimum temp for the 24-hr period when applications were made were as follows: in 1969, 12.2 – 26.1°C at first-bloom, 18.9 – 27.8° at peak bloom, and 17.2 – 31.7° at verasion; in 1970, 4.4 – 21.7°; and in 1971, 9.4 – 27.2°.

Fruit was harvested at the time of commercial harvest in 1969. Three harvest dates were designed into the 1970 and 1971 studies:

a. Early (1 week prior to peak commercial harvest)
b. Mid (at peak commercial harvest)
c. Late (1 week after peak commercial harvest)

Representative samples consisting of 2 basal clusters for quality analysis were collected from each plot at the time of harvest each year and immediately frozen in non-vented polyethylene bags for later analysis. Berries were separated from stems, counted, and weighed to determine individual berry wt and no. of berries/cluster. All fruit that were entirely green on each cluster were weighed to determine % green fruit. The samples were then blended for 15 sec in an Osterizer blender, placed in 250 ml beakers, warmed to 20°C, and % solids was determined using a Bausch and Lomb Abbe refractometer.

Beakers containing the blended samples were covered with watch glasses and placed in a water bath at 85°C for 1 hr, removed and allowed to cool to approximately 40°. Pulp was removed by straining samples through 2 layers of coarse cheesecloth. A 5 ml aliquot of juice was diluted to 100 mls using distilled water and centrifuged for 30 minutes at 4000 rpm. Percent transmittance was read on the centrifuged samples using a Bausch and Lomb spectrophotometer (model 340) at 520 nm. (Distilled water was used as a reference to set the instrument on 100% transmittance.)

Another 10 ml aliquot of juice was placed in a 250 ml beaker and diluted to 125 ml using distilled water. The sample was titrated to pH 7 with 0.1 N NaOH using a magnetic stirrer and a portable Analytical Measurements (model 707) pH meter.

Table 1. Effects of daminozide concn and time of application on yield and fruit characteristics of 'Concord' grapes, 1969.

Treatment	Yield (kg/vine)	Berry wt (g)	Berries/ cluster	Cluster wt (g)
Daminozide concn				
0 ppm	7.4a[z]	3.0a	41c	187b
1000 ppm	9.3a	2.9a	53b	209a
2000 ppm	8.8a	2.9a	62a	194ab
3000 ppm	9.0a	2.9a	65a	201ab
Application time				
First bloom	9.0ab	2.8b	65a	189a
Full bloom	9.4a	2.9b	59b	204a
Verasion	7.5b	3.1a	41c	201a

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

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Table 2. Effects of daminozide concn on yield and fruit characteristics of 'Concord' grapes.[z]

Daminozide concn	Yield (kg/vine)	Berry wt (g)	Berries/ cluster	Cluster wt (g)	Cluster length (cm)	Cluster width (cm)
1970						
0 ppm	8.3b[y]	2.7a	46c	132b	11.4b	7.1c
500 ppm	9.2ab	2.5b	58b	154a	11.7b	8.1b
750 ppm	9.6ab	2.4bc	68a	162a	11.9ab	8.6a
1000 ppm	10.7a	2.3c	71a	166a	12.4a	8.6a
1971						
0 ppm	7.1a	2.8a	54a	152a	–	–
500 ppm	6.7a	2.8a	54a	148a	–	–
750 ppm	7.9a	2.8a	54a	152a	–	–
1000 ppm	7.3a	2.7a	56a	152a	–	–

[z]Means of 3 harvest dates.

[y]Mean separation in columns by Duncan's multiple range test, 5% level.

Table 3. Effects of daminozide concn on dormant pruning wt of 'Concord' grapes.

Daminozide concn (ppm)	Pruning wt (kg/vine)		
	1969	1970	1971
0	2.5[z]a	1.5a	2.3a
500	–	1.3ab	2.2a
750	–	1.0bc	1.8ab
1000	2.2a	0.9c	1.6b
2000	1.5b	–	–
3000	1.7b	–	–

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

Table 4. Effects of daminozide concn and time of application on quality attributes of 'Concord' grapes, 1969.

Treatment	Soluble solids (%)	Tit. acidity[z] (ml)	Trans-mittance[y] (%)	Green by wt[x] (%)
Daminozide concn				
0 ppm	16.5a[w]	10.4a	62b	2a
1000 ppm	15.7ab	10.2a	70a	6ab
2000 ppm	15.5b	10.0a	73a	9bc
3000 ppm	15.3b	10.0a	72a	10c
Application time				
First bloom	15.6ab	10.2a	69ab	9b
Full bloom	15.3b	10.0a	71a	9b
Verasion	16.3a	10.2a	67b	3a

[z]ml of 0.1N NaOH required to titrate 10 ml juice to pH 7.

[y]% transmittance at 520 nm based on 5 ml juice diluted to 100 ml with distilled water and centrufuged.

[x]% of berries on each cluster totally green.

[w]Mean separation in columns within treatments by Duncan's multiple range test at 5% level.

In addition to all quality attributes previously described, cluster length, width (at shoulder), and weight (including cluster rachis and stem) were determined at harvest in 1969.

With the exception of cluster length and width measurements which were deleted, the same observations were made in 1971 as in 1970.

The studies were designed as factorial randomized complete blocks with 9 replications. Data were subjected to a factorial analysis of variance (6).

Results and Discussion

Effects on fruiting. Daminozide had no significant influence on yield in 1969 (Table 1). Yield of vines treated at verasion were similar to that for all non-treated vines, while those treated at peak-bloom showed a yield increase of 1.9 kg/vine.

Table 5. Effects of daminozide concn and time of harvest on quality of 'Concord' grapes, 1970.

Treatment	Soluble solids (%)	Tit. acidity[z] (ml)	Trans-mittance[y] (%)	Green by wt[x] (%)
Daminozide concn				
0 ppm	14.3a[w]	9.7a	46c	3a
500 ppm	13.9ab	9.4a	55b	4a
750 ppm	13.4bc	9.6a	61a	8b
1000 ppm	13.1c	9.4a	65a	7b
Harvest date				
Early (Aug. 17)	13.1b	8.5c	60a	7b
Mid (Aug. 24)	13.3b	10.4a	59a	5a
Late (Sept. 1)	14.6a	9.6b	50b	4a

[z]ml of 0.1N NaOH required to tiltrate 10 ml juice to pH 7.

[y]% transmittance at 520 nm based on 5 ml juice diluted to 100 ml with distilled water and centrifuged.

[x]% of berries on each cluster totally green.

[w]Mean separation in columns within treatments by Duncan's multiple range test, 5% level.

Daminozide increased yields in 1970, but only the high concn (1000 ppm) yielded significantly more fruit than the control (Table 2). Neither the fruiting characteristics measured nor yield was affected by daminozide in 1971 (Table 2).

The increase in yields due to 1000 ppm daminozide in 1970 was a result of increased no. of berries/cluster (Table 2). Although berry size was reduced, cluster wt was still increased. Similarly, applications of daminozide at first- or peak-bloom in 1969 increased the no. of berries/cluster and reduced berry size as compared to the application at verasion (Table 1). This late application would not be expected to effect the no. of berries/cluster or berry size since the time of fruit set is well past and berries are nearly fully developed.

In 1970, yield increases due to daminozide application seem to be related not only to the no. of berries/cluster and cluster wt, but also to cluster length and width (at shoulder) (Table 2). Greater development of the shoulder was evident upon visual examination of clusters from daminozide-treated vines. Also, these clusters appeared more compact than clusters from non-treated vines.

Table 6. Effects of daminozide concn and time of harvest on quality of 'Concord' grapes, 1971.

Treatment	Soluble solids (%)	Tit. acidity[z] (ml)	Trans-mittance[y] (%)	Green by wt[x] (%)
Daminozide concn				
0 ppm	17.2a[w]	11.5ab	46a	0a
500 ppm	16.6a	10.7b	46a	1a
750 ppm	16.7a	11.1ab	51a	1a
1000 ppm	17.1a	11.8a	47a	0a
Harvest date				
Early (Aug. 25)	16.2b	12.3a	52a	0a
Mid (Aug. 31)	16.9a	11.3b	48ab	1a
Late (Sept. 7)	17.5a	10.2c	44b	1a

[z]ml of 0.1 N NaOH required to titrate 10 ml juice to pH 7.

[y]%transmittance based on 5 ml juice diluted to 100 ml with distilled water and centrifuged.

[x]% of berries on each cluster totally green.

[w]Mean separation in columns within treatments by Duncan's multiple range test, 5% level.

Effects on vegetative growth. Daminozide concn of 2000 ppm or higher reduced pruning wt in 1969 (Table 3). However, 750 ppm in 1970 and 1000 ppm in 1971 reduced pruning wt as compared to controls. Reductions in pruning wt by daminozide support predictions by Tukey and Fleming (7, 8) that alterations in balanced pruning may be necessary if daminozide is used year after year.

Effects on fruit and juice quality. Application of daminozide caused an increase in % green fruit and a reduction in % soluble solids in 1969 and 1970 (Tables 4 and 5). Maturity in 1969 appeared to be retarded most by daminozide applied at peak-bloom (Table 4), when increases in berries/cluster and yield were induced. Neither % green fruit nor % soluble solids were affected by daminozide in 1971 (Table 6), when berries/cluster and yield were not affected. In the years that daminozide showed an effect, larger yields from daminozide treated vines coupled with the possibility of lowered membrane permeability, believed to be caused by daminozide (9), made sugar accumulation more difficult and resulted in lowered juice quality.

Transmittance through juice at 520 nm was higher for samples from treated vines in 1969 and 1970 (Tables 4 and 5). No change in color was associated with daminozide in 1971 (Table 6). Reduction in % transmittance values as harvest was delayed in 1970 and 1971 (Tables 5 and 6) indicates increased color development.

Neither daminozide concn nor time of application affected titratable acidity in 1969 (Table 4). Acid content varied only with harvest dates in 1970 and 1971 (Tables 5 and 6).

Conclusions

Results of this study have substantiated reports that daminozide may increase yields of 'Concord' grapes when applied between first- and peak-bloom. However, yield increases were not observed in every year. Since increases in production parallel increases in berries/cluster, daminozide may be of value when conditions at or prior to bloom are unfavorable for adequate fruit set. This study also confirms results reported by other researchers that daminozide is capable of retarding vegetative growth of 'Concord' vines.

Application of daminozide appeared to adversely affect certain indicators of 'Concord' grape juice quality, but only when yields were increased. Since reduced maturity and color intensity were attributed to the greater fruit load of daminozide-treated vines, use of daminozide may result in unacceptable juice quality when treatments result in over production. Primary control of production should still be achieved through regulation of pruning severity, but daminozide applied between first- and peak-bloom at the rate of 1000 ppm may insure a good crop in years when certain environmental factors might otherwise cause yields to be low. In addition, daminozide might insure good fruit set in those vineyards where fruit set is usually a problem.

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